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For: Enertec Green Ltd

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ENERTEC GREEN LTD

STACK HEIGHT ANALYSIS FOR HAPTON VALLEY TRANSFER STATION

HAPTON VALLEY

1 Introduction

A stack height analysis has been undertaken to advise on a suitable stack height for a waste recycling facility on Land at Hapton Valley Transfer Station, Burnley. The facility will be located on a vacant plot within the existing Envirofuel (SRF) Ltd waste management facility. The facility has been designed to process approximately 24,000 tonnes of pelletised solid recovered fuels per annum. The fuel for the proposed development will be generated by the adjacent Envirofuel facility.

A range of stack heights has been considered between 17 m and 35 m at 3 m increments. The starting stack height of 17 m is 3 m above the main building associated with the facility and is the minimum stack height that would be recommended.

The facility is associated with the emission of a number of pollutants in concentrations that are potentially significant. However, this assessment has focussed on maximum predicted concentrations of the oxides of nitrogen (NOx) and a comparison of annual mean concentrations of nitrogen dioxide (NO2) with the Air Quality Objective (AQO) of 40 µg m 3. This approach is based upon the understanding that NOx, and in particular NO2, are likely to be the pollutant most likely to drive the decision relating to an appropriate stack height. The AQO is for assessing impacts on human health.

2 Dispersion Modelling Assumptions

Dispersion modelling has been carried out using the UK Atmospheric Dispersion Modelling System (ADMS) Version 6.0. The following are assumed:

- Emissions via a single stack;
- Modelling for one year of Bingley meteorological data (2015 which gives rise to the highest annual mean for a 26 m stack);
- Terrain effects have been included;
- A main building of height 14 m, 73 m in length and 44 m in width and angle of 104° has been included (Building E in Table 1);
- Additional buildings have been included, refer to Table 1;
- A surface roughness value of 0.5 m has been adopted;
- A 4 km by 4 km grid of 40 m resolution centred around the stack emission has been used;
- Predicted concentrations are the maximum anywhere within the model domain;
- NO to NO_2 conversion of 70% for predicting annual mean NO_2 concentrations, in accordance with Environment Agency guidance.

Predicted concentrations are based on the current Industrial Emissions Directive (IED) emission limit for NO_x (200 mg Nm^{-3}) for the thermal treatment of waste.

Table 1: Building Downwash Structures					
Building	Easting	Northing	Height	Dimensions	Angle
Building A	380905	431472	14.7 m	66 x 35 m	60
Building B	380915	431420	13.4 m	49 x 53 m	60
Building C	380999	431391	10.6 m	36 x 61 m	47
Building E	380991	431340	14.0 m	73 x 44 m	104
ATR 1	380900	431363	11.9 m	11 x 10 m	50
ATR 2	380909	431352	11.9 m	11 x 10 m	50
Workshop	380940	431385	12.0 m	16 x 30 m	50

3 Stack Height Sensitivity

Predicted annual mean concentrations of NO_2 are presented in *Figure 1* for a range of stack heights between 17 m and 35 m. The purpose of this graph is to determine an 'optimum' stack height, by identifying a compromise between the required mitigation on impacts from air quality and the increased negative impacts of increasing stack height. Results are also summarised in *Table 2*.

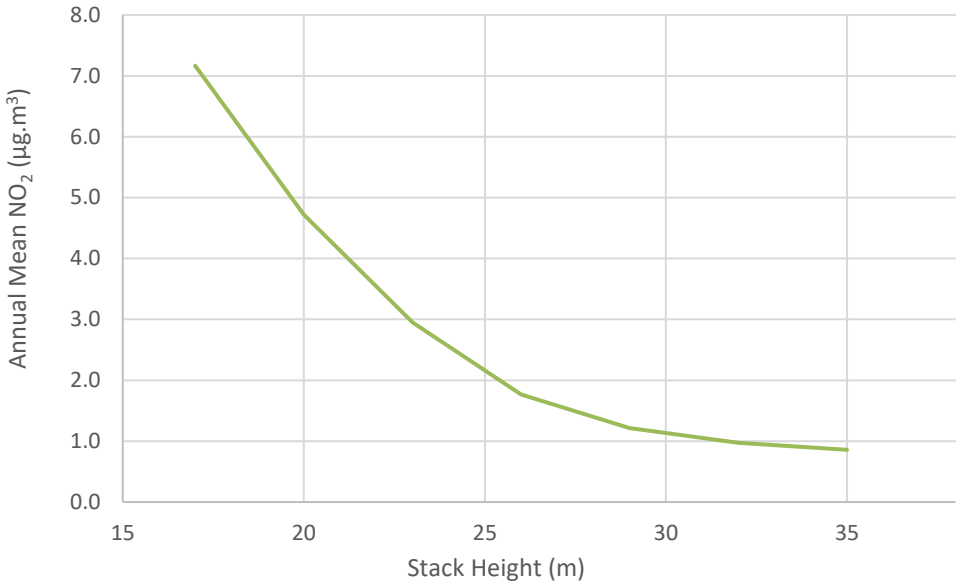

Figure 1: Stack Height Sensitivity

Table 2: Summary of Predicted Annual Mean Concentrations of NO_2		
Stack Height	NO_2 (µg m ^{3})	NO^2 as %age of AQO
17 m	7.2	17.9%
20 m	4.7	11.8%
23 m	3.0	7.4%
26 m	1.8	4.4%
29 m	1.2	3.0%
32 m	1.0	2.4%
35 m	0.9	2.1%

Predicted concentrations decrease with increasing stack height as would be expected. Beyond 26 m, the decrease in concentrations becomes less with increasing stack height and represents an optimum stack height. At this stack height the facility contributes 4.4% of the AQO. However, it should be noted that this is the maximum predicted anywhere within the model domain and occurs within the industrial estate where there is no relevant public exposure.

4 Assessment of Predicted Nitrogen Dioxide Concentrations

4.1 Background Concentrations

It is necessary to define the baseline air quality against which the process contribution (PC) will be added to determine the predicted environmental concentration (PEC). An elevated baseline will give less headroom for any additional emissions. A review of background NO2 concentrations based on the Defra mapping data indicates that a background annual mean concentration of 12.7 µg m 3 would be appropriate for NO2. However, diffusion tube monitoring data obtained from Burnley Borough Council indicates concentrations at roadside locations are higher. The average annual mean concentration at five nearby monitoring sites (DT18, DT20b, DT28, DT49 and DT52) in 2019 was 28.2 µg m 3. This is substantially higher than the Defra mapped background data and has been used in order to present a very worst-case for the stack height analysis.

4.2 Summary of Maximum Predicted NO_2 Concentrations for Various Stack Heights

Dispersion modelling of emissions has been carried out for the 23 m, 26 m, 29 m 32 m and 35 m stack heights. Predicted annual mean NO2 concentrations for 2015 (worst case year) are presented in Table 3. Concentrations of NO2 have been calculated assuming a 70% NO to NO2 conversion.

Predicted concentrations are compared to the AQO and baseline concentrations. The impacts are described, for planning purposes, based on the Institute of Air Quality Management's (IAQM) planning guidance.

Table 3: Summary of Predicted Annual Mean Concentrations of NO2				
Parameter	23 m	26 m	29 m	32 m
Annual mean NO_2 ($\mu g\ m^{-3}$)	3.0	1.8	1.2	1.0
PC as %age of AQS	7%	4%	3%	2%
PEC (with background) ($\mu g\ m^{-3}$)	31.2	30.0	29.4	29.2
PEC as %age of AQS	78%	75%	74%	73%
Significance	Slight adverse	Negligible	Negligible	Negligible

For all stack heights, the PC is in excess of 1% of the AQO and the impact is potentially significant. However, except for 23 m, the PEC for all stack heights is less than or equal to 75% of the AQO and based on the IAQM guidance the impact for these stack heights would be described as 'negligible'. For the 23 m stack height, the impact would be described as slight adverse principally due to the adopted worst-case baseline conditions. It should also be noted that predicted concentrations are the maximum anywhere within the model domain and occur within the industrial estate where there is no relevant public exposure.

5 Cost Effectiveness Analysis

The Environment Agency has provided Internal Guidance on undertaking a stack height assessment for waste incineration projects. This includes a cost effectiveness analysis (CEA). A cost-effectiveness analysis is where the cost per unit of pollution reduction is calculated for a variety of options so that they can be compared. A CEA for stack height would be based on the costs of increasing height against the predicted PC of the pollutants. Best Available Techniques (BAT) would be the point at which increasing costs outweigh any further benefits in reducing the PC. Using the guidance provided by the Agency and assuming that the cost of increasing the stack height is linear between 17 m and 35 m at £50k per 3 metre increase, the additional cost of increasing stack height against the PC as a percentage of the AQO is presented in Figure 2 and Table 4.

Table 4: Cost Effective Analysis			
Stack Height	NO_2 ($\mu g\ m^{-3}$)	Cost Above 17 m	NO_2 as %age of AQO
17 m	7.2	-	17.9%
20 m	4.7	£50k	11.8%
23 m	3.0	£100k	7.4%
26 m	1.8	£150k	4.4%
29 m	1.2	£200k	3.0%
32 m	1.0	£250k	2.4%
35 m	0.9	£300k	2.1%

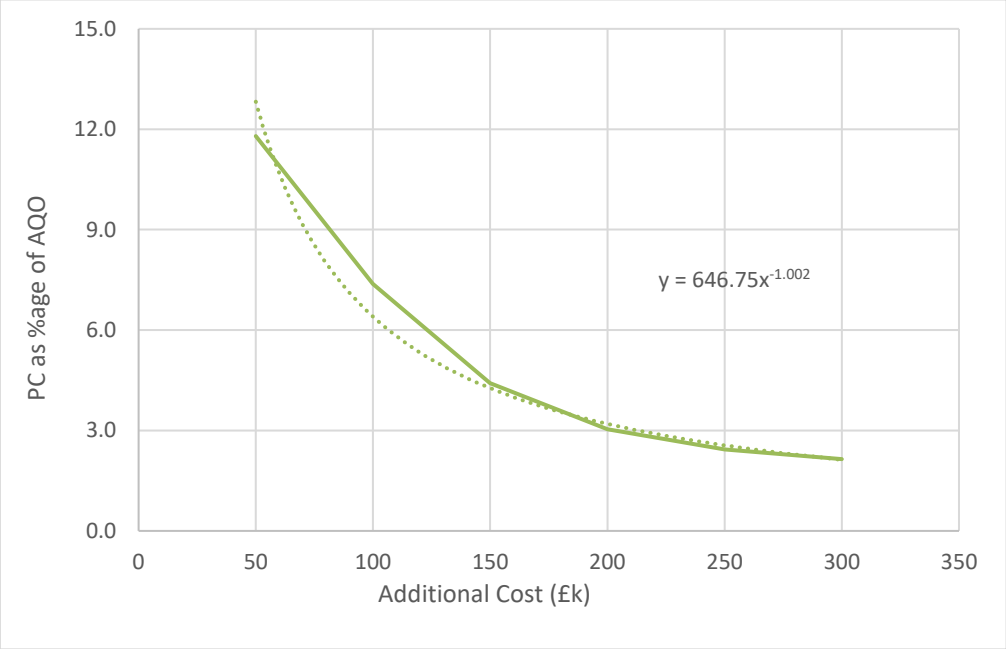

Figure 2: Cost Effectiveness Analysis for Stack Height

Solving the equation for the curve where the slope is at 45° (i.e. y = -15/350) gives an x-value of £122k which would correspond to a stack height of between 23 m and 26 m. This is the trade-off point and it occurs where a line drawn at 45° just touches the curve of the graph marking the extra cost of increasing the stack height against PC as a percentage of the AQO.

Recommendations

Based on this stack height analysis, it is concluded that a proposed stack height of 26 m would be adequate to satisfy planning and permitting requirements.